FURBEARER CARCASS STUDY, GATES OF THE ARCTIC NATIONAL PARK AND PRESERVE, ALASKA - THREE YEAR SUMMARY

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SHELLI A. SWANSON, U.S. National Park Service; P.O. Box 74680, Fairbanks, Alaska 99709

Abstract: Red fox (*Vulpes vulpes*), lynx (*Lynx canadensis*), marten (*Martes americana*), and wolverine (*Gulo gulo*) carcasses were purchased from trappers operating in and near Gates of the Arctic National Park and Preserve to collect information on furbearer population dynamics. Alaska Department of Fish and Game fur sealing records were summarized for the area to examine past and present furbearer harvests. Sex ratios were male-dominated for all furbearer species necropsied during the 3-year study except wolverines in 1989-90. Based on tooth cementum analysis, 82% of the red fox (*n* = 142), 31% of the lynx (*n* = 26), and 72% of the wolverine carcasses (*n* = 25) were juveniles. The age structure of the lynx harvest was bimodal, with 27% of the animals being <1 year old and 58% >6 years old. All adult female red foxes bore placental scars as well as 10% of the red fox juveniles. Only 2 of 7 adult female wolverines bore placental scars and both were 2-year-olds. Resource managers can use this information to direct and prioritize future furbearer research needed to maintain natural and healthy furbearer populations in the park and preserve area.

INTRODUCTION

The National Park Service (NPS) is directed by the 1980 Alaska National Interest Lands Conservation Act (ANILCA) to "...protect habitat for and the populations of fish and wildlife..." in Gates of the Arctic National Park and Preserve (Title II, sec. 201). ANILCA also requires NPS to provide for subsistence use of park resources by local residents. Furbearers, such as beaver (*Castor canadensis*), red fox, lynx, marten, wolf (*Canis lupus*), and wolverine, constitute an important subsistence resource in the park and preserve. To maintain healthy furbearer populations and provide for continued use of these populations by subsistence trappers, information is needed on furbearer population dynamics and past and present furbearer harvest in the park and preserve area.

The extent of trapping in the park and preserve is currently unknown. Trappers living in the 10 resident-zone communities of Alatna, Allakaket, Ambler, Anaktuvuk Pass, Bettles/Evansville, Hughes, Kobuk, Nuiqsut, Shungnak, and Wiseman are permitted to trap on park as well as preserve land. Harvest information is available from Alaska Department of Fish and Game (ADF&G) fur sealing records, fur buyer records, and import-export permits, but harvest estimates from these sources are lower than the actual harvest. Animals harvested for personal use are often not reported/sealed and there are few ADF&G offices or sealing agents in rural areas. To assess the harvested furbearer population, NPS began purchasing and necropsying carcasses from trappers operating in and near the park during the 1988-89 trapping season. Additionally, fur sealing records were obtained from ADF&G to examine past furbearer harvests.

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STUDY AREA

Gates of the Arctic National Park and Preserve is located above the Arctic Circle in the central Brooks Range, Alaska (Fig. 1). The 33,182 km^2 park and preserve unit spans 2 climate zones: the subarctic zone at low altitudes south of the Brooks Range and the arctic zone to the north. Precipitation is low within the

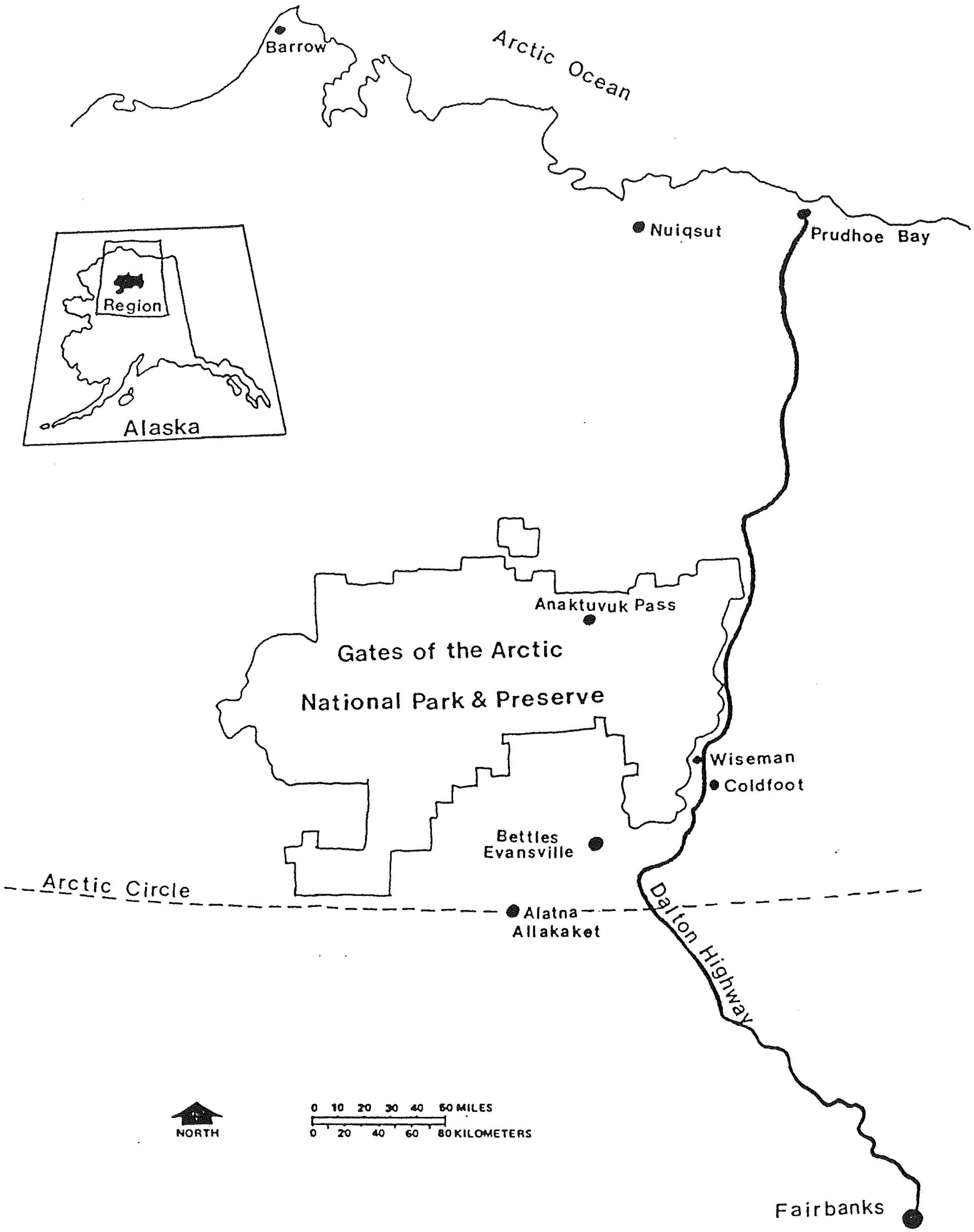

Fig. 1. Location of Gates of the Arctic National Park and Preserve, Brooks Range, Alaska.

park and preserve, ranging from 30 - 46 cm in the west to 13 - 25 cm in the north. Snow falls average 152 - 203 cm in the south and 89 - 127 cm in the north. Temperatures in the south fluctuate from average July maximums of 18 - 21^0 C (65 - 70^0 F) to average January minimums of -29 - -34^0 C (-20 - -30^0 F). Temperatures in the north fluctuate from average July maximums of 13 - 18^0 C (55 - 65^0 F) to average February minimums of -21 - -23^0 C (-5 - -10^0 F) (National Park Service 1986).

Boreal forest, tundra, and shrub thickets are the major vegetation communities in the park/preserve (National Park Service 1986). The dense boreal forest south of the mountains, composed of black spruce (Picea mariana), white spruce (P. glauca), paper birch (Betula papyrifera), aspen (Populus tremuloides), and balsam poplar (Populus balsamifera), extends into the southern flanks and valleys of the Brooks Range. Boreal forest is replaced at treeline by shrub birch (Betula spp.), willow (Salix spp.), and alder (Alnus spp.) thickets. Dense willow/alder thickets occur along stream channels and gravel bars at lower elevations. Alpine tundra is found at higher altitudes and on dry ridges and contains low-growing willow, Dryas spp., Saxifraga spp., and lichens. Moist tundra, composed primarily of cotton sedge (Eriophorum spp.), forms in moderate to poorly drained soils in the foothills, mountainsides, and river valleys.

METHODS

Furbearer carcasses were purchased from trappers operating in and near the park and preserve during 3 trapping seasons from 1988-1991. Carcasses were necropsied and the following data was recorded: 1.) sex, 2.) body, skull, and upper canine length, 3.) heart girth, 4.) rump, sternum, and flank fat depths, 5.) visceral fat estimation (none, scarce, moderate, or abundant), 6.) gastro-intestinal contents, 7.) parasites, and 8.) infirmities. A canine tooth was pulled from fox, lynx, wolverine, and wolf carcasses and sent to Matson's Laboratory in Milltown, Montana for age determination by tooth cementum analysis. Placental scars were counted from uterine tracts to assess previous reproductive effort. In 1990, ovaries were preserved in formaldehyde and corpora lutea were counted.

Lynx tongues were collected for ADF&G biologists studying the incidence of trichinosis in lynx, but analysis for the disease has not yet been completed. Skulls were cleaned for exhibit specimens and collections were sent to schools in Bettles and Anaktuvuk Pass. Skulls and samples of liver, kidney, heart, and muscle tissue from 3 wolves, a wolverine, and a coyote taken near Anaktuvuk Pass were collected for the University of Alaska Museum frozen tissue collection.

In addition to carcasses, marten skulls were purchased to determine the age (juvenile or adult) and sex of the harvest based on skull measurements (Magoun et al. 1991). Marten skulls representing the different sex and age classes were photographed. In 1990, the canine and first and second premolars of 11 marten were aged by tooth cementum analysis to compare the accuracy of the method using different teeth and to investigate the possibility of pulling a first premolar from live-trapped marten to determine age.

Furbearer sealing records from 1985-1991 were obtained from ADF&G. Furbearers taken and sealed in subunits of ADF&G Game Management Units 23, 24, 25, and 26 in and within 58 km of the park and preserve boundaries were counted to examine regional harvest trends (Appendix I).

RESULTS

During the study, 158 red fox, 3 arctic fox (*Alopex lagopus*), 28 lynx, 31 wolverine, 1 coyote (*Canis latrans*), and 4 wolf carcasses were necropsied and 466 marten skulls were examined. Twenty-three trappers participated in the study in 1988-89, but their numbers dropped to 10 in 1989-90 and 9 in 1990-91.

Sex and Age

With a few exceptions, male furbearers were captured more frequently than females (Table 1). A 50:50 male to female ratio occurred in the red fox harvest in 1989-90 and in the lynx harvest in 1990-91. More female than male wolverines were harvested during the 1989-90 trapping season. Wolverine sex ratios varied more between years than those for red fox, marten, and lynx (Table 1). Wolverine sex ratios from ADF&G fur sealing records for the park and preserve area also varied strongly between years from 1984-1991 (Table 2).

Juvenile furbearers (<2 years old as determined by tooth cementum aging) were harvested more frequently than adults (Fig. 2). When aged by tooth cementum analysis, 82% of the red fox (n = 142), 31% of the lynx (n = 26), and 72% of the wolverine carcasses (n = 25) were juveniles. More adult lynx than juveniles were harvested during 2 of the trapping seasons (Table 3). The proportion of harvested juvenile to adult martens was nearly equal during all 3 years of the study (Table 3); 70% of the adult martens (n = 213) were males.

The age structure of the harvested population differed between red fox, lynx, and wolverine (Fig. 2). The 0 (or young-of-the-year) age class constituted 58% of the red fox harvest and was thus most heavily harvested. The age structure of the lynx harvest was bimodal, with high numbers of lynx in both the 0 and 7-year-old age classes (Fig. 2). Fifty-eight percent of the lynx carcasses examined were >6 years old (n = 28). Few lynx 4 - 6 years old were harvested. The 2-year-old age class was most highly represented in the wolverine harvest (Fig. 2).

Table 1. Percentage of males (M):females (F) for furbearer carcasses (n) purchased from trappers in and near Gates of the Arctic National Park and Preserve, Alaska, 1988-1991.

Season	Red Fox M:F (n)	Marten M:F (n)	Wolverine M:F (n)	Lynx M:F (n)
1990-91	68:32 (34)	67:33 (109)	67:33 (9)	50:50 (10)
1989-90	50:50 (34)	65:35 (46)	40:60 (10)	60:40 (5)
1988-89	52:48 (90)	63:37 (311)	75:25 (12)	69:31 (13)
Overall	55:45 (158)	64:36 (466)	61:39 (31)	61:39 (28)

Table 2. Percentage of known males(M):females(F) for furbearers (n) harvested in and near Gates of the Arctic National Park and Preserve, Alaska, 1984-1991. Data from Alaska Department of Fish and Game pelt-sealing records.

Year	Lynx		Otter		Wolf		Wolverine	
	M:F	(n)	M:F	(n)	M:F	(n)	M:F	(n)
1990-91	*		0:100	(2)	55:45	(31)	63:37	(20)
1989-90	*		50:50	(4)	56:44	(41)	44:56	(18)
1988-89	*		43:57	(7)	52:48	(56)	53:47	(19)
1987-88	59:41	(66)	53:47	(15)	56:44	(81)	62:38	(34)
1986-87	52:48	(50)	73:27	(11)	59:41	(37)	50:50	(16)
1985-86	45:55	(66)	0:100	(4)	57:43	(35)	79:21	(24)
1984-85	41:59	(86)	0:100	(1)	54:46	(37)	63:37	(24)

* Sex data not recorded for lynx after 1987-88.

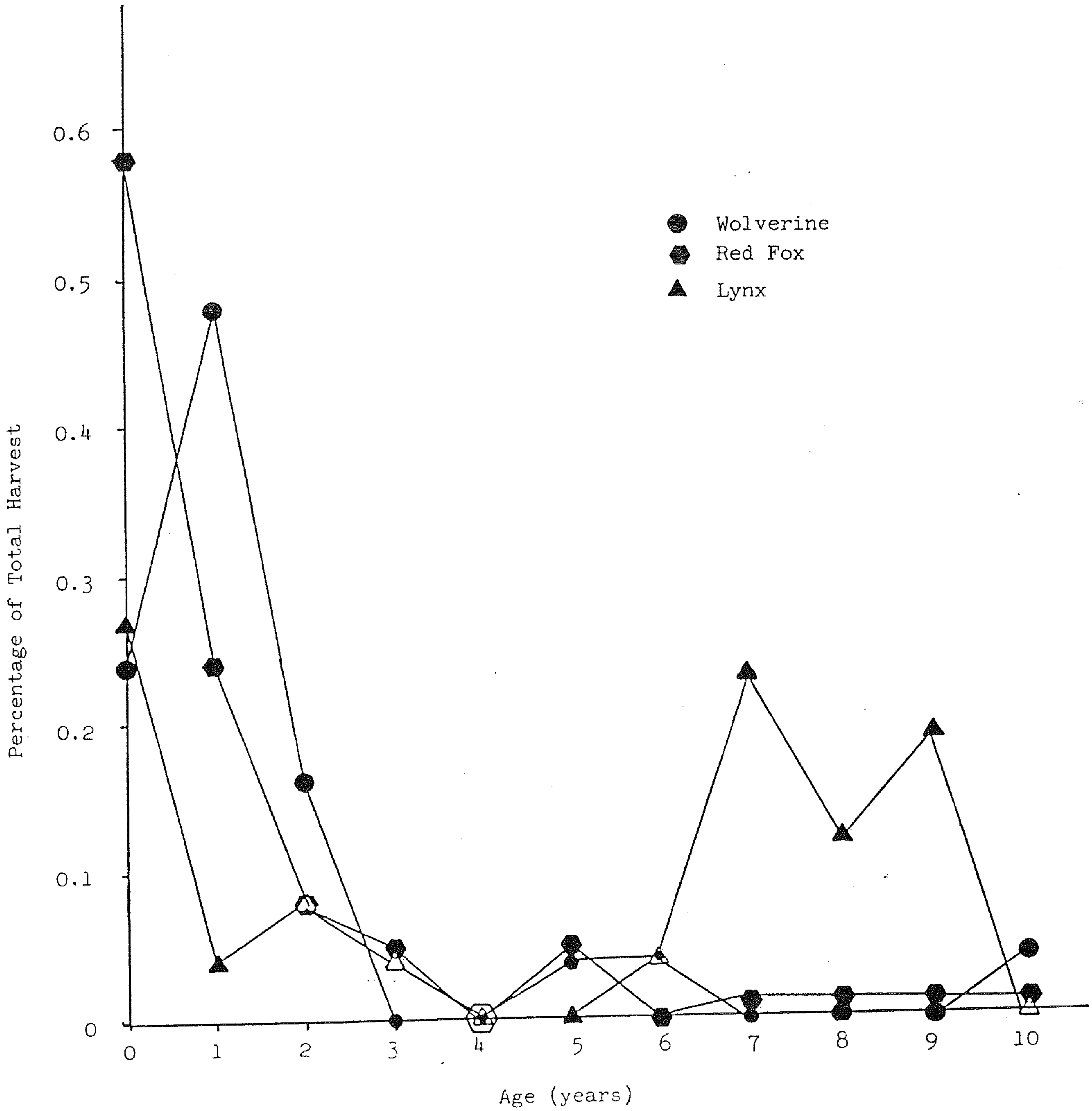

Fig. 2. Age composition of wolverine, red fox, and lynx harvests taken in and near Gates of the Arctic National Park and Preserve, Brooks Range, Alaska, 1988-1991. Age was determined by counting tooth cementum annuli in canine teeth of furbearer carcasses purchased from trappers. Where points overlap symbols are hollow.

Table 3. Percentage of juveniles[a] (J):adults (A) and juveniles (J): adult females (AF) of furbearer carcasses (n) purchased from trappers in and near Gates of the Arctic National Park and Preserve, Alaska, 1988-1989.

Season	Red Fox		Marten		Wolverine		Lynx	
	J:A (n)	J:AF (n)	J:A (n)	J:AF (n)	J:A (n)	J:AF (n)	J:A (n)	J:AF (n)
1990-91	79:21 (34)	93:7 (29)	49:51 (109)	75:25 (71)	75:25 (8)	75:25 (8)	20:80 (10)	33:67 (6)
1989-90	100:0 (23)	100:0 (23)	45:55 (60)	71:29 (38)	62:38 (8)	71:29 (7)	60:40 (5)	60:40 (5)
1988-89	79:21 (85)	88:12 (76)	60:40 (226)	82:18 (166)	64:36 (11)	78:22 (9)	30:70 (10)	60:40 (5)
Overall	82:18 (142)	91:9 (128)	55:45 (395)	79:21 (275)	67:33 (27)	75:25 (24)	32:68 (25)	50:50 (16)

[a]Juveniles are animals <2 years old as determined by tooth cementum aging.

Canine teeth were most reliable in determining marten age, though premolars were reliable indicators in 73% of the cases (*n* = 11; Table 4). Major sources of error in using premolars for age determination included a "juvenile" dark cementum layer that obscured other layers, peripherally compressed annual layers, and resorption of cementum causing annual layers to merge (G. Matson, Matson's Lab. pers. commun.).

Reproduction

Adult female red fox reproduction was high and 10% of the juveniles were reproductively active. Placental scars were found on 25% of the red fox uterine tracts examined (*n* = 63), and a mean of 5.6 placental scars was obtained from these 16 tracts. All adult females captured bore placental scars (*n* = 11), and 5 of the 52 juvenile uterine tracts had placental scars. Two juveniles necropsied during the 1988-89 trapping season had ovulated, producing 6 and 3 corpora lutea respectively, but no placental scars were observed; a 1-year-old had 6 embryos, corresponding to the 6 corpora lutea found in her ovaries.

Lynx reproduction was moderate to low. Five of the lynx uterine tracts examined (*n* = 11) bore placental scars, averaging 4.8 scars per tract. Fifty-six percent of the adult females were reproductively active (*n* = 9), but the 2 juvenile female lynx examined had no placental scars. One 7-year-old female had 6 corpora lutea, but no placental scars.

Reproduction in wolverines is low to moderate. Only 2 of the adult females examined had placental scars (*n* = 7); two 2-year-old wolverines had 2 and 3 placental scars respectively. None of the 5 juvenile female wolverines had placental scars, but a corpora lutea was observed on the ovary of a 1-year-old.

Body Condition

Mean rump, sternum, and flank deposit measurements for red fox, lynx, and wolverine were in the lower 50% of their respective ranges (Table 5). Mean visceral fat rankings were in the scarce to moderate range for red fox and wolverines but was in the moderate to high range for lynx (Table 5). Intraspecific fat depth comparisons between years was not statistically different due to high variances and small sample sizes.

Parasite incidence was low in red fox and wolverine, but moderately high in lynx. In carcasses examined for parasites, parasites were found in 19% of the red fox (*n* = 67), 46% of the lynx (*n* = 28), and 29% of the wolverines (*n* = 31). Nematode cysts of *Cylicospirura* spp. were located in the stomachs of 46% of the lynx examined; cysts also were located in 1 wolverine and 2 foxes during the 1990-1991 trapping season. Free-roaming nematodes were located in the digestive tracts of 26% of the wolverines and 16% of the red foxes. No free-roaming nematodes were located in lynx digestive tracts.

Table 4. Tooth cementum ages (yr) obtained from the canine (C), first premolar (PM1), and third premolar (PM3) teeth of 11 marten (*Martes americana*) trapped in and near Gates of the Arctic National Park and Preserve, Alaska, 1989. Teeth were sectioned and aged by Matson's Laboratory, Milltown, Montana.

Identification Number	C	PM1	PM3	Best Age[a]	Most Reliable Teeth for Aging
1	1	0	0	1	C
2	1	*	0	1	C
3	0	1	0	0	C,PM3
4	0	0	0	0	C,PM1,PM3
5	0	0	0	0	C,PM1,PM3
6	0	0	0	0	C,PM1,PM3
7	1	1	1	1	C,PM1,PM3
8	2	1	1	2	C
9	2	1	*	1	PM1
10	1	0	0	0	PM1,PM3
11	1	*	1	1	C,PM3

[a]Determined by Matson's Laboratory.
* indicates uncertain age estimate of 0-1 yr.

Table 5. Mean fat deposit measurements for red fox, wolverine and lynx trapped in and near Gates of the Arctic National Park and Preserve, Alaska, 1988-1991.

Species	Rump Fat (mm) (n)	Sternum Fat (mm) (n)	Flank Fat (mm) (n)	Visceral Fat[a] (n)
Red fox	0.4 (65)	0.5 (57)	1.2 (65)	1.5 (144)
Range (mm)	0 - 2.0	0 - 3.2	0 - 7.0	
Wolverine	1.5 (27)	1.7 (25)	3.1 (27)	1.7 (27)
Range	0 - 7.0	0 - 5.8	0 - 9.0	
Lynx	1.4 (19)	1.0 (14)	2.1 (17)	2.5 (24)
Range	0 - 5.0	0 - 4.0	0 - 5.0	

[a]Visceral fat deposits were rated according to the following scale: 0 = none, 1 = scarce, 2 = moderate, and 3 = abundant.

Skeletal and soft tissue injuries, in addition to those incurred in the trap, were commonly observed. Infirmities in the examined carcasses included broken jaws and other facial bones, dead and broken teeth, and broken ribs. A coyote taken from Anaktuvuk Pass in 1990 had a porcupine quill in its liver. A wolf examined from Anaktuvuk Pass had extensive bruising in the muscles of its hindquarters.

A diseased red fox from the Wiseman area was examined and had extensive yellow fluid and fat under the hide. These symptoms are typical of streatitis or "yellow fat" disease, caused by an inflammation of the adipose tissue and concurrent deposition of ceroid pigment in the interstices of the adipose cells (Siegmund 1973). The disease has been documented in domestic cats and mink and is associated with consumption of an overabundance of unsaturated fatty acids (mainly from fish) combined with a deficiency of vitamin E.

Gastro-intestinal contents for red fox included microtine rodents, ruffed grouse, caribou, and unidentified ungulate hair that may have been Dall sheep. The stomach of 1 red fox was packed full of disposable diaper materials. Human food wastes, such as corn and plum pits, were identified in foxes trapped near villages with dump sites. Caribou, hare, ptarmigan, squirrel, and dall sheep remains were found in lynx stomachs. Wolverine gastro-intestinal tracts were often filled only with trap debris (sticks, vegetation, and soil), though caribou hair and meat was located in several.

ADF&G Fur Sealing Records

The number of trappers sealing furs from the park and preserve area have declined from a high of 63 in 1985-86 to a low of 27 in 1990-91 (Table 6). Reported lynx harvest in the park and preserve area peaked during the 1985-86 season and has remained relatively low since 1988-89 (Table 7). Reported wolf and wolverine harvests were high during the 1987 and 1988 trapping seasons and since have declined. High beaver harvests were taken from the park and preserve region from 1986 to 1989 and during the 1990-91 season; beaver harvest appears to be independent of the general decline in trapper numbers. Land otter (Lutra canadensis) harvests also were high during high beaver harvest years, apparently due to incidental capture in beaver traps.

More furbearers are currently being sealed from the western district (west of the John River and south of the Colville River drainage basin) in the park and preserve area. Prior to 1989, the number of furbearers sealed in the eastern district (park and preserve area east of the John River and south of the continental divide) was higher than in the western and northern districts (Table 7); the northern district includes land north of the continental divide and Anaktuvuk Pass. An increase in beaver

Table 6. Number of trappers sealing furbearer skins in and near Gates of the Arctic National Park and Preserve, Alaska, 1984-1991. Data from Alaska Department of Fish and Game pelt-sealing records.

1990-91	27 Trappers
1989-90	No information*
1988-89	No information*
1987-88	54 Trappers
1986-87	49 Trappers
1985-86	63 Trappers (49 names + 14 licenses w/o names)
1984-85	56 Trappers

*Trapper names were not available from AK Fish and Game in the sealing record database.

Table 7. Furbearers harvested (n) and percentage of total harvest for 3 areas in and adjoining Gates of the Arctic National Park and Preserve, Alaska, 1984-1991. Data obtained from Alaska Department of Fish and Game pelt-sealing records.

Year/ Area	Beaver	Lynx	Otter	Wolf	Wolverine	% Total Harvest
1990-91						
East	37	31	0	5	6	30
West	128	12	2	17	9	63
North	0	3	0	11	5	7
Overall	165	46	2	33	20	
1989-90						
East	9	33	0	10	6	32
West	65	1	4	17	12	56
North	0	0	0	16	5	12
Overall	74	34	4	43	23	
1988-89						
East	63	20	2	12	13	54
West	21	1	5	26	4	28
North	3	9	0	23	3	18
Overall	87	30	7	61	20	
1987-88						
East	175	61	2	28	13	62
West	60	4	13	35	9	27
North	0	18	0	21	12	11
Overall	235	83	15	84	34	
1986-87						
East	143	54	2	22	6	68
West	51	10	9	6	10	26
North	0	8	0	10	2	6
Overall	194	72	11	38	18	
1985-86						
East	24	85	1	11	19	51
West	52	27	3	6	6	35
North	0	17	0	18	3	14
Overall	76	129	4	35	28	
1984-85						
East	16	114	2	18	15	72
West	25	5	0	15	9	23
North	0	5	0	4	2	5
Overall	41	124	2	37	26	

harvest from the western district and concurrent decrease in the eastern district was largely responsible for this shift.

DISCUSSION

Sex and Age

Sex ratios can be used to evaluate harvest intensity, and harvests with equal or predominantly female sex ratios generally indicate overharvest (Strickland and Douglas 1987). It is desirable to harvest more males than females in a population since the population birthrate, and hence, population size and density, is determined by the percentage of reproducing females. Males are often more active, covering larger territories than females and thus increasing their chance of capture. Soukkala (1983) found that 2-3 male marten are often trapped to each female. Variables such as food abundance, habitat conditions, and trapping pressure also influence sex ratios (Strickland and Douglas 1987).

The male-dominated sex ratios found in this study were supported by data collected by Golden (1988) and ADF&G (Table 2) and are typical of furbearer populations. The 1989-90 wolverine harvest (Table 1) was an exception to the male-dominated harvest but probably was the result of small sample size bias. Several trappers interviewed in the area maintained that they temporarily closed their traplines if a high percentage of female martens were being trapped to protect the core breeding stock for the following year.

The age composition of the harvest also can be used to identify population trends in furbearer populations. A high proportion of juveniles in the harvest may indicate an increasing population and good rearing success. Juvenile animals are particularly vulnerable to trapping and other sources of mortality, due to dispersal, inexperience in locating natural food sources, and excessive curiosity, and therefore usually compose a high proportion of the harvest. However, if too many juveniles are being harvested the population will decline. The percentages of red fox and wolverine juveniles in the harvest (Figs. 2 and 3) indicate that these populations are healthy, but information on survival of juveniles is needed to accurately interpret this data.

The bimodal age structure of the lynx harvest in this study also was found by Golden (1988), who believed it was due to a depressed though probably increasing population. Females in the older age classes are harvested more often in exploited populations (Hash 1987), and though harvest pressure on lynx in the area does not appear to be high, all reproductively active adult female lynx were >6 years old.

It is difficult to make predictions about the status of the lynx population in the park and preserve area from the small number of lynx carcasses examined in this study. However, there are several potential indicators of stress in the harvested lynx population: 1.) more adults than juveniles were harvested in 2 of the 3 years during the study, 2.) 6 corpora lutea were found in an adult lynx but no placental scars, indicating that the eggs or embryos were aborted or reabsorbed, 3.) few kittens were observed with adult females and mammary development was nonexistent in trapped females during the 1990-91 trapping season, and 4.) a lynx kitten ear and fur was found in the stomach of an adult lynx during 1991. Additionally, several fights between lynx in 1990-91 were noted in the Wiseman area, where most of the adult female lynx were trapped.

The above stress indicators may be characteristic of old females in marginal or unfamiliar territory. Lynx may have moved into the Wiseman area from the Yukon Flats where populations are reportedly high (J. Reakoff, Wiseman trapper, pers. commun.). Lynx moving into this area may be older animals forced out of prime habitats in the Yukon Flats and into marginal or less densely populated areas.

Based on ADF&G sealing records for the park and preserve area, lynx harvest declined from a high in 1985-86 (when lynx prices were high) to a low in 1988-89 (Tables 2 and 7, Appendix I). There is some possibility that the lynx populations in the eastern district crashed after the 1982 hare cycle peak and then were heavily harvested from 1984-88, thereby causing a second population low from which they are still recovering. In Game Management Unit 24 (as well as statewide) the 10-year lynx cycle peaked in 1981-82 and should peak again in 1991-92 (Osborne 1984, Osborne 1990). The number of lynx sealed from the park and preserve area for 1990-91 was higher than the 2 previous years, and if harvest levels are indicative of population size, lynx should be on the upswing of their population cycle. Hare populations in the Wiseman area appeared to be high in 1991-92 (J. Reakoff, Wiseman trapper, pers. commun.), which should result in increased survival and reproduction.

Though the marten harvest contained nearly equal proportions of juveniles and adults, the population probably is not being overharvested, since most of the adults were males. In all 3 years of the study, marten juvenile:adult ratios were lower than the 68:32 ratio found by Golden (1988).

Reproduction

Reproductive information is necessary to determine the effects of harvest on animal populations (Gilbert 1987). Reproductive efforts of a harvested population can be estimated by counting: 1.) corpora lutea ("scars" left on the ovary by each egg released during a reproductive cycle), 2.) placental scars (dark bands retained on the uterine horn where each embryo was attached), and 3.) blastocysts (fertilized eggs not yet implanted in the uterus). Intrauterine losses (eggs or embryos reabsorbed or aborted) are determined by subtracting the number of placental scars from the number of corpora lutea. Factors effecting reproductive output include food availability and diversity, population density, and mortality pressures, both man-induced (trapping and hunting) and natural causes (disease, starvation, etc.). In general, high density populations have fewer breeding juveniles and adults. Both low density populations and heavily stressed populations with high annual mortality often are characterized by a high percentage of yearlings producing litters and high numbers of breeding adults; litter sizes also are larger (Gilbert 1987).

Based on reproductive information, red fox numbers appear to be moderate to high, since high density populations often have low numbers of reproductively active juveniles. However, the high percentage of reproductively active adult females indicates a moderate to low population density, potentially with high annual mortality. The average 5.6 placental scars obtained in this study appears to be in the middle range for red fox populations; reported litter sizes (based on placental scar counts) range from a low of 4.2 in Europe to a high of 8 in Ontario (Voigt 1987).

Lynx reproductive rates and kitten survival are directly related to food availability. The number of young per litter decline in periods of hare scarcity; lynx placental scar counts in Alberta dropped from an average 4.6 placental scars to 3.4 during a hare population decline (Brand and Keith 1979). In our study, the average lynx litter size (based on the average 4.8 placental scars) is high, and fifty-six percent of the adult female lynx examined produced kittens the year they were trapped, indicating a moderate population level. In spite of the relatively high percentage of reproductively active adults (56%), few kittens were seen by trappers working in the park, which suggests low kitten survival.

Generally, wolverine litter sizes range from 1 - 5 young, with 2 - 3 kits being more common (Hash 1987). The 2 reproductively active wolverines in our study had 2 and 3 placental scars respectively, falling within the normal litter size. Wolverine population levels appear to be moderate, since only 29% of the adult female wolverines examined had placental scars and none of the juveniles were reproductively active.

Furbearer Sealing Record Information

Alaska Department of Fish and Game monitors changes in furbearer populations and trapper effort through pelt sealing records; all pelts of lynx, beaver, land otter, wolf and wolverine are required to be sealed by ADF&G. Compliance with the sealing requirements is low within the park and preserve area due to lack of personnel to seal pelts in remote villages and immediate use of unsealed pelts by the local community for ruffs and other subsistence handicrafts. For example, only an estimated 10% of the wolves taken by Anaktuvuk Pass trappers during 1990-91 were sealed. Both wolf and wolverine pelts are seldom sealed due to their high demand for parka ruffs. Harvest data for Anaktuvuk Pass have been kept by Bob Ahgook during the past few years and has provided more accurate harvest information for the area than sealing records.

The downward trend in trapper numbers in the park and preserve area parallels a general downward trend in fur prices. High fur prices, especially for lynx pelts in the mid-1980's, may have increased the number of trappers in the park and preserve area at that time, particularly in the eastern portion of the park where the Dalton Highway provided easy access to trapping areas. Furbearer prices are currently low, and lynx pelt prices dropped from a high of $350 in 1985 to a high of $80 in 1991, if pelts were even being purchased (Arctic Raw Fur Company, Fairbanks, Alaska, pers. commun.).

MANAGEMENT RECOMMENDATIONS

The need for baseline population data on nearly all furbearer species is needed to enable park staff to determine the health and productivity of area furbearer populations and to properly manage them as natural and healthy populations. Priority species for furbearer research in the park and preserve are 1.) wolves in the Anaktuvuk Pass area, 2.) lynx, 3.) marten, 4.) wolverine, 5.) fox, and 6.) beaver. Baseline population work involving collaring and radio-telemetry is expensive and attempts should be made to work on these projects co-operatively with ADF&G, U.S. Fish and Wildlife Service, and/or Bureau of Land Management. A joint NPS and ADF&G research project has monitored wolf populations in the park since 1987, but because wolf harvest in Anaktuvuk Pass was very high in 1990-91, NPS should continue data collection to monitor the harvest level in this area.

Until extensive population projects can be conducted, NPS should continue the carcass work described in this study and interview trappers working in and near the park. Data gained from the carcass study is based on small, often biased sample sizes, but it is still useful to detect gross trends and temporal shifts in abundance and distribution in furbearer populations. One recommended change in the carcass work is to measure kidney fat instead of rump, sternum, or flank fat. External fat deposits are subject to change with trapper skinning technique and shrinkage with freeze/thaw activity and time. Visual estimates of visceral fat should be continued as this fat reserve is used last and is not affected by trapper handling. Additional studies involving track counts and food availability, such as small mammals, would add valuable information to current knowledge of furbearer species in the park.

The current study has raised many questions about furbearer populations in the park and preserve area. By using this information to direct and prioritize future furbearer research projects, hopefully, we can obtain the necessary data to effectively manage for natural and healthy furbearer populations in and near the park and preserve.

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APPENDIX I. Alaska Department of Fish and Game furbearer sealing records for game management units and subunits in and near Gates of the Arctic National Park and Preserve, Alaska, 1984-1991.

Table A1. Number of beaver (BV), lynx (LY), otter (OT), wolf (WF), and wolverine (WV) trapped in each Game Management Unit (GMU) by subunit, 1990-1991. Data from Alaska Department of Fish and Game pelt-sealing records.

<u>GMU = 23Z</u>

2502	1 WF
2601	31 BV, 1 OT
2701	1 WF, 4 WV
0101	1 WV

<u>GMU = 24Z</u>

0502	69 BV, 1 OT, 8 WF
0802	9 BV, 2 LY
0901	19 BV, 7 LY
0903	1 LY, 3 WF, 3 WV
0904	2 LY, 2 WF
0905	2 WF
0906	1 LY
0907	1 WV
1001	19 BV, 1 LY
1101	25 BV, 5 LY
1103	3 LY
1105	2 WF
1201	1 BV
1214	3 LY, 2 WF
1402	1 WV
1501	2 LY
1503	1 WF
1504	2 BV, 6 LY, 1 WF, 2 WV
1506	4 LY, 1 WF, 3 WV
1514	1 LY

<u>GMU = 25A</u>

None

<u>GMU = 26A</u>

0701	1WF
0801	1 WF, 1 WV
0803	1 WF
0901	1 WF, 1 WV
1001	2 WF, 1 WV

<u>GMU = 26B</u>

0202	1 WF, 2 WV
0309	2 WF

Table A2. Number of beaver (BV), lynx (LY), otter (OT), wolf (WF), and wolverine (WV) trapped in each Game Management Unit (GMU) by subunit, 1989-1990. Data from Alaska Department of Fish and Game pelt-sealing records.

GMU = 23Z

2301	1 WV
2601	56 BV, 1 WV
2701	3 OT
2801	1 WF
4602	1 WF
4702	3 WF, 1 WV
4704	1 WF, 1 WV

GMU = 24Z

0502	6 BV, 1 OT, 3 WV
0802	2 LY, 1 WF
0901	3 BV, 1 WF
0903	7 WF, 2 WV
0904	1 WV
0912	1 WF
1001	1 LY, 1 WF
1002	2 WV
1101	4 BV, 8 LY, 1 WF
1103	1 WF
1104	1 LY, 1 WF, 1 WV
1105	2 BV, 9 LY, 2 WF, 1 WV
1211	1 WF
1212	4 WF
1213	1 LY, 3 WF
1504	3 BV, 8 LY, 3 WV
1508	2 WF

GMU = 25A

0201	6 LY, 1 WF, 1 WV
0403	1 WF

GMU = 26A

0801	2 WF
0803	1 WF
0901	2 WV
1003	2 WF
1301	1 WV
1303	1 WF

GMU = 26B

0202	1 WV
0309	6 WF
0103	1 WV

Table A3. Number of beaver (BV), lynx (LY), otter (OT), wolf (WF), and wolverine (WV) trapped in each Game Management Unit (GMU) by subunit, 1988-1989. Data from Alaska Department of Fish and Game pelt-sealing records.

GMU = 23Z

1900	5 WF, 1 WV
1903	1 WF
2301	1 OT
2400	1 WV
2601	14 BV, 4 OT
4702	1 WF

GMU = 24Z

0502	2 OT, 2 WF
0802	7 BV, 3 LY, 2 WF, 2 WV
0901	5 BV, 1 LY
0902	4 WF
0903	3 WF, 2 WV
0905	2 WF
1001	2 BV, 9 WF
1101	23 BV, 6 LY
1102	22 BV
1103	1 LY, 1 WF, 1 WV
1104	1 WF
1106	1 WF
1107	2 WF
1201	5 LY, 1 WF
1206	1 LY
1207	1 LY, 1 WF
1212	4 LY, 1 WV
1301	3 BV
1401	1 BV
1407	3 LY, 1 WF
1413	2 WF
1501	2 WF
1503	3 BV, 2 WF, 4 WV
1504	7 BV, 1 LY, 2 WV
1506	1 LY
1513	2 LY

GMU = 25A

0201	1 LY, 2 WV
0302	1 WV

GMU = 26A

0701	6 WF
0703	1 WF
0901	1 WV
1004	1 WF
1101	1 WF
1303	4 WF

GMU = 26B

0101	1 WF
0202	4 WF, 1 WV
0309	1 WF

Table A4. Number of beaver (BV), lynx (LY), otter (OT), wolf (WF), and wolverine (WV) trapped in each Game Management Unit (GMU) by subunit, 1987-1988. Data from Alaska Department of Fish and Game pelt-sealing records.

GMU = 23Z

4102	1 WF
4500	1 WF
4501	6 WF
1900	6 WF
1901	3 WF
1902	1 WV
2101	1 WF
2301	2 OT
2401	4 WF
2600	2 WF
2700	6 OT
2701	1 WF
2800	22 BV
2801	1 WV
3001	4 WV

GMU = 24Z

0502	18 BV, 3 WF
0503	6 WF, 4 BV, 1 WV
0504	1 OT
0802	6 BV, 17 LY, 1 WV
0901	4 LY, 1 OT, 7 WF, 1 WV
0902	1 WF
0904	2 WV, 2 WF
1001	6 WF, 1 WV
1101	30 BV, 3 LY, 1 WF
1102	43 BV
1103	58 BV, 3 WV
1105	16 BV
1106	2 WF
1201	3 WF, 2 WV
1206	5 LY
1207	1 LY
1208	1 LY, 2 WV
1212	2 WF
1301	4 WF
1401	1 LY
1407	2 LY
1412	9 LY, 1 WV, 3 WF
1501	9 LY, 1 WV, 3 WF
1504	4 LY, 1 WV
1505	1 LY
1506	1 LY
1508	1 WF
1510	1 WV
1514	11 LY

GMU = 25A

0201	7 LY
0302	1 WF
0402	1 WF, 6 LY, 1 WV
0403	1 LY

GMU = 26A

0701	2 WV
0703	3 WF
0800	1 WF
0802	1 WV
0803	4 WF
1000	1 WV
1003	1 WF
1300	1 LY

GMU = 26B

0309	1 WF, 1 WV

Table A5. Number of beaver (BV), lynx (LY), otter (OT), wolf (WF), and wolverine (WV) trapped in each Game Management Unit (GMU) by subunit, 1986-1987. Data from Alaska Department of Fish and Game pelt-sealing records.

GMU = 23Z

1900	1 LY
2400	1 WV
2500	2 WV
2600	1 WF
2601	28 BV, 1 OT, 1 WV
2701	5 OT
2800	1 WV, 20 BV
3001	3 OT, 2 BV

GMU = 24Z

0502	40 BV, 2 OT
0503	5 BV, 2 OT
0802	8 BV, 23 LY, 1 WF, 1 WV
0901	7 LY
0903	1 BV, 5 WF, 1 WV
0905	5 WF
1000	2 BV
1001	1 WF
1100	40 BV, 7 LY, 6 WF
1101	40 BV, 7 LY, 6 WF
1102	41 BV
1103	1 BV, 1 WF
1105	1 BV, 2 LY, 1 WF
1107	1 BV
1108	1 WV
1201	2 LY, 1 WV
1202	2 WF, 1 WV
1204	1 LY
1205	2 LY, 3 WV
1207	3 WF, 2 LY
1210	1 WV
1212	2 LY
1303	1 LY
1304	1 LY
1401	1 LY
1412	2 LY
1501	4 LY, 2 BV, 2 WF
1503	1 LY, 5 WF, 1 WV
1504	2 BV, 3 LY, 3 WF, 1 WV
1505	1 LY
1508	5 LY

GMU = 25A

0201	1 LY

GMU = 26A

0801	4 WF
0803	1 LY, 1 WV
1101	1 WV

GMU = 26B

0300	1 WF

Table A6. Number of beaver (BV), lynx (LY), otter (OT), wolf (WF), and wolverine (WV) trapped in each Game Management Unit (GMU) by subunit, 1985-1986. Data from Alaska Department of Fish and Game pelt-sealing records.

GMU = 23Z

2300	3 LY
2500	1 WF
2600	31 BV, 2 OT
2800	1 LY, 1 WV
3000	1 BV, 1 OT

GMU = 24Z

0502	3 BV, 4 LY, 1 OT, 1 WF, 3 WV
0503	4 LY
0802	17 LY, 5 WV
0901	10 BV, 3 LY, 1 WV
0902	10 BV, 3 LY, 1 WV
0903	9 LY, 3 WV
0908	4 LY
1001	2 BV, 1 LY
1100	1 LY
1101	2 BV, 1 LY
1102	12 BV
1103	2 LY, 3 WF
1104	4 LY
1107	1 LY
1108	1 LY
1200	1 WV
1201	5 BV
1207	1 WF
1212	12 LY, 2 WF, 1 WV
1304	1 LY, 1 WF
1403	2 LY
1408	1 LY
1412	2 LY
1501	4 LY, 1 WV
1503	3 LY, 1 WF
1504	5 LY, 1 WF, 2 WV
1508	4 LY, 1 WF
1514	7 LY, 2 WV

GMU = 25A

0300	2 WF
0400	1 LY
0402	3 LY, 2 WV
0403	1 LY

GMU = 26A

0700	2 LY
0801	5 WF
0802	5 WF
1003	3 WF
1004	1 WV

GMU = 26B

None sealed

Table A7. Number of beaver (BV), lynx (LY), otter (OT), wolf (WF), and wolverine (WV) trapped in each Game Management Unit (GMU) by subunit, 1984-1985. Data from Alaska Department of Fish and Game pelt-sealing records.

GMU = 23Z

1900	6 WF, 1 WV
2300	2 LY
2500	3 BV, 2 WV
2600	2 WF
2601	20 BV, 2 WV
2701	6 WF
2800	3 LY
2801	2 BV
2900	1 WV
3001	1 LY
3002	1 LY
4500	2 WV

GMU = 24Z

0500	2 WF
0502	5 BV, 1 WF
0504	1 WV
0802	28 LY, 1 WF, 5 WV
0901	13 LY, 3 WF
0904	3 LY, 1 WF, 1 WV
0911	1 LY
1000	1 WF
1001	1 LY
1101	10 LY, 1 WF, 1 WV
1104	1 WV
1105	8 BV, 2 OT
1201	4 LY, 1 WV
1207	5 LY
1304	9 LY
1403	1 LY
1406	3 LY
1501	3 LY, 1 WF
1503	1 LY
1504	2 BV, 18 LY, 2 WV
1508	2 LY
1514	8 LY, 1 WF, 1 WV

GMU = 25A

0300	1 WF
0302	1 BV, 6 LY, 2 WF, 1 WV
0400	2 WF
0402	1 LY
0403	2 LY, 1 WF

GMU = 26A

0703	2 WF
0803	2 WF
1003	1 WF
1303	1 WF

GMU = 26B

None sealed